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A61K 39/395 (2006.01) A61P 35/00 (2006.01)

Ealing, London W5 3QR (GB). ROWLINSON-BUSZA, Gail [GB/GB]; Antisoma Plc, West Africa House, Hanger Lane, Ealing, London W5 3QR (GB).

(21) International Application Number:

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(71) Applicant (for all designated States except US): ANTI-SOMA PLC [GB/GB]; West Africa House, Hanger Lane, Ealing, London W5 3QR (GB).

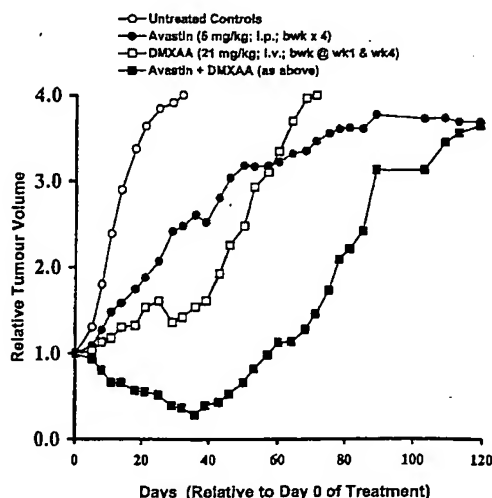
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(72) Inventors; and

(75) Inventors/Applicants (for US only): GREEN, Colin [GB/GB]; Antisoma Plc, West Africa House, Hanger Lane, Ealing, London W5 3QR (GB). KELLAND, Lloyd [GB/GB]; Antisoma Plc, West Africa House, Hanger Lane,

[Continued on next page]

(54) Title: COMBINATIONS COMPRISING DMXAA FOR THE TREATMENT OF CANCER



(57) Abstract: The present invention relates to combinations of compounds such as compounds of the xanthenone acetic acid class such as 5,6-dimethylxanthenone-4-acetic acid (DMXAA) and vascular endothelial growth factor binders, in particular the monoclonal antibody Avastin™ (bevacizumab). More particularly, the invention is concerned with the use of such combinations in the treatment of cancer and pharmaceutical formulations containing such combinations.

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## INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2006/003196

## A. CLASSIFICATION OF SUBJECT MATTER

INV. A61K31/352 A61K39/395 A61K31/337 A61P35/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61K A61P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, BIOSIS, EMBASE, WPI Data, CHEM ABS Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	DJEHA H ET AL.: "Synergistic in vivo antitumor activity in lung and colon cancer xenografts with the vascular disrupting agent DMXAA combined with bevacizumab" PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR CANCER RESEARCH ANNUAL MEETING; 97TH ANNUAL MEETING OF THE AMERICAN ASSOCIATION-FOR-CANCER-RESEARCH (AACR), vol. 47, April 2006 (2006-04), page 55, XP001248753 Washington, DC, USA ISSN: 0197-016X abstract  ----- -/--	1-36



Further documents are listed in the continuation of Box C.



See patent family annex.

## \* Special categories of cited documents:

\*A\* document defining the general state of the art which is not considered to be of particular relevance

\*E\* earlier document but published on or after the International filing date

\*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

\*O\* document referring to an oral disclosure, use, exhibition or other means

\*P\* document published prior to the International filing date but later than the priority date claimed

\*T\* later document published after the International filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*&amp;\* document member of the same patent family

Date of the actual completion of the International search

13 December 2006

Date of mailing of the International search report

29/12/2006

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## INTERNATIONAL SEARCH REPORT

International application No  
PCT/GB2006/003196

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 03/020259 A2 (CANCER REC TECH LTD [GB]; WILSON WILLIAM ROBERT [NZ]; SIIM BRONWYN GAE) 13 March 2003 (2003-03-13) page 18, line 29 - page 19, line 30 table 1 page 22, paragraph 2 - page 23	1-36
A	SIIM BRONWYN G ET AL: "Marked potentiation of the antitumour activity of chemotherapeutic drugs by the antivascular agent 5,6-dimethylxanthenone-4-acetic acid (DMXAA)." CANCER CHEMOTHERAPY AND PHARMACOLOGY. JAN 2003, vol. 51, no. 1, January 2003 (2003-01), pages 43-52, XP002411268 ISSN: 0344-5704 abstract	1-36
A	BAGULEY BRUCE C ET AL: "Potential of DMXAA combination therapy for solid tumors." EXPERT REVIEW OF ANTICANCER THERAPY. OCT 2002, vol. 2, no. 5, October 2002 (2002-10), pages 593-603, XP009076041 ISSN: 1473-7140 the whole document	1-36
A	KELLAND LR: "Targeting Established Tumor Vasculature: A Novel Approach to Cancer Treatment" CURR. CANCER THER. REV., vol. 1, no. 1, January 2005 (2005-01), pages 1-9, XP002411269 ISSN: 1573-3947 page 5, column 1, paragraph 3 - page 6, column 2, paragraph 3	1-36

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB2006/003196

### Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:  
  
Although claims 1-14, 20-24 are directed to a method of treatment of the human/animal body, the search has been carried out and based on the alleged effects of the compound/composition.
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

### Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2006/003196

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 03020259	A2	13-03-2003	BR 0212258 A	19-10-2004
			CA 2458459 A1	13-03-2003
			CN 1708296 A	14-12-2005
			EP 1423105 A2	02-06-2004
			IS 7144 A	06-02-2004
			JP 2005509599 T	14-04-2005
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			NO 20040591 A	30-04-2004
			NZ 531045 A	31-08-2006
			US 2004204480 A1	14-10-2004
			ZA 200401078 A	15-04-2005
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(71) Applicant (for all designated States except US): ANTI-SOMA PLC [GB/GB]; West Africa House, Hanger Lane, Ealing, London W5 3QR (GB).

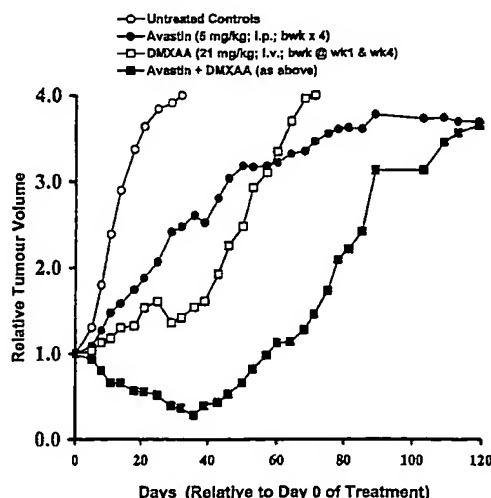
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(57) Abstract: The present invention relates to combinations of compounds such as compounds of the xanthenone acetic acid class such as 5,6-dimethylxanthenone-4-acetic acid (DMXAA) and vascular endothelial growth factor binders, in particular the monoclonal antibody Avastin™ (bevacizumab). More particularly, the invention is concerned with the use of such combinations in the treatment of cancer and pharmaceutical formulations containing such combinations.



**Declaration under Rule 4.17:**

- *of inventorship (Rule 4.17(iv))*

**Published:**

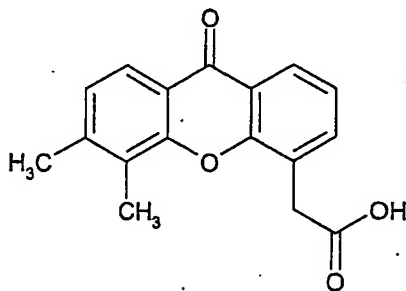
- *with international search report*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## COMBINATIONS COMPRISING DMXAA FOR THE TREATMENT OF CANCER

The present invention relates to combinations of compounds of the class having the formula (I) as defined below, for example compounds of the xanthenone acetic acid class having the formula (II) as defined below, such as 5,6-dimethylxanthenone-4-acetic acid (DMXAA), or a pharmaceutically acceptable salt, ester or prodrug thereof and vascular endothelial growth factor (VEGF) binders, in particular the monoclonal antibody Avastin™ (bevacizumab). The combinations of compounds described above may also include a taxane, in particular paclitaxel or docetaxel. For example, the present invention relates to synergistic combinations of compounds of the class having the formula (I) as defined below, for example compounds of the xanthenone acetic acid class having the formula (II) as defined below, such as 5,6-dimethylxanthenone-4-acetic acid (DMXAA), or a pharmaceutically acceptable salt, ester or prodrug thereof and anti-angiogenic growth factor inhibitors, in particular the monoclonal antibody Avastin™ (bevacizumab), a VEGF binder and such combinations may also include a taxane, in particular paclitaxel or docetaxel. More particularly, the invention is concerned with the use of such combinations in the treatment of cancer. The present invention also relates to pharmaceutical compositions containing such combinations.

5,6-Dimethylxanthenone-4-acetic acid (DMXAA) is represented by the following formula:



25

Three phase I clinical trials of DMXAA as a monotherapy have recently been completed, with dynamic MRI showing that it induces a significant reduction in tumour blood flow at well-tolerated doses. DMXAA is thus one of the first

vascular disrupting agents (VDAs) for which activity (irreversible inhibition of tumour blood flow) has been documented in human tumours. These findings are in agreement with preclinical studies using syngeneic murine tumours or human tumour xenografts which showed that its antivascular activity produced prolonged  
5 inhibition of tumour blood flow leading to extensive regions of haemorrhagic necrosis.

However, in these phase I clinical trials of DMXAA there were very few tumour responses, demonstrating that DMXAA alone does not have significant potential  
10 in cancer treatment as a single agent. Therefore, there is a need to identify compounds that could have a synergistic effect with DMXAA.

There is a new class of cancer drugs available that are not cytotoxics, but block the growth factor signalling pathways. Examples include Avastin™ (bevacizumab), a  
15 humanised monoclonal antibody that binds to vascular endothelial growth factor (VEGF). By doing so, it inhibits angiogenesis (growth of new blood vessels), starving growing tumour of nutrients. We have surprisingly found that DMXAA may act synergistically with these new agents, enhancing their anti-cancer activity.

## 20 Vascular Endothelial Growth Factor

Tumours have been found to overexpress certain growth factors that enable them to proliferate rapidly. Chief among these is VEGF. Tumours secrete VEGF, which stimulates endothelial proliferation and migration through two high-affinity  
25 receptor-associated tyrosine kinases found primarily on the vascular endothelium, VEGF-R1 (Flt-1) and VEGF-R2 (Flk-1/KDR). Expression levels of VEGF are negatively correlated with prognosis and survival in cancer, and inhibiting its binding to its receptor has been shown to improve survival.

30 VEGF is targeted by Avastin™ (bevacizumab, a humanised monoclonal antibody marketed by Genentech in the US and Roche elsewhere). The antibody binds directly to VEGF, preventing it from binding to VEGF receptors on the vascular endothelium. This means that the new blood vessels required by the tumour do not

develop, and it cannot grow. Avastin™ combined with standard chemotherapy has been shown to offer a survival advantage over standard chemotherapy alone in colorectal, lung and breast cancers in phase III trials.

#### **Previous DMXAA combination studies**

DMXAA has previously been demonstrated to have synergy with a number of agents in xenograft studies. These agents include widely used cytotoxic chemotherapies such as taxanes (paclitaxel and docetaxel), platins (cisplatin and carboplatin), vinca alkaloids (vincristine), antimetabolites (gemcitabine), topoisomerase II inhibitors (etoposide) and anthracyclines (doxorubicin). It is believed that the synergy arises because DMXAA causes necrosis in the centre of tumours by disrupting the blood vessels that supply the core, but it leaves a viable rim of rapidly proliferating cancer cells that are supplied by normal blood vessels. These remaining malignant cells are targeted by the cytotoxic agents, which primarily act by disrupting cell division in various ways.

DMXAA is currently in two phase II trials examining its anti-tumour efficacy in combination with paclitaxel and carboplatin, and one trial combining it with docetaxel. Although the taxanes are believed to have anti-angiogenic properties, this is via a very different mechanism from the growth factor inhibitors. The cytotoxic effect of the taxanes is caused by interference with tubulin, which prevents normal mitosis (cell division). This is the main effect seen at the high doses of the taxanes used in cancer chemotherapy. A secondary effect is disruption of newly formed blood vessels, since the cells of the new vascular endothelium depend on tubulin to maintain their shape. However, this effect is normally seen only at doses too low to be cytotoxic. Any synergy between DMXAA and the taxanes is thought to be a result of the targeting of different parts of the tumour, as described above, rather than due to its anti-angiogenic properties.

Other agents have also been shown to enhance the activity of DMXAA in xenograft studies. Although the exact mechanism of action of DMXAA is not

understood, it is believed to cause upregulation of various cytokines, and compounds with similar activity appear to enhance its effectiveness. These include tumour necrosis factor stimulating compounds and immunomodulatory compounds such as intracellular adhesion molecules (ICAMs).

5

Diclofenac, an NSAID that has been shown to enhance the anti-tumour activity of DMXAA, is believed to affect the PK of DMXAA via competition for metabolic pathways. At a concentration of 100µM, diclofenac has been shown to significantly inhibit glucuronidation (>70%) and 6-methylhydroxylation (>54%) of DMXAA in mouse and human liver microsomes. *In vivo*, diclofenac (100mg/kg i.p.) has been shown to result in a 24% and 31% increase in the plasma DMXAA AUC (area under the plasma concentration-time curve) and a threefold increase in  $T_{1/2}$  ( $P<0.05$ ) in male and female mice respectively (Zhou *et al.* (2001) *Cancer Chemother. Pharmacol.* 47, 319-326). Other NSAIDs have been shown to have a similar effect.

15

Similarly to diclofenac, thalidomide, which is approved for erythema nodosum leprosum (ENL), seems to enhance the activity of DMXAA. It competes for glucuronidation, prolonging DMXAA's presence at therapeutic levels in tumour tissue. Thalidomide increases the AUC of DMXAA by 1.8 times in plasma, liver and spleen and by three times in tumour (Kestell *et al.* (2000) *Cancer Chemother. Pharmacol.* 46(2), 135-41). Thalidomide is known to have anti-angiogenic effects, but these are not believed to be responsible for its synergy with DMXAA. It would not be expected that combining with vascular endothelial growth factor binder would have a similar effect to that of thalidomide on the effectiveness of DMXAA.

20

25

#### Previous vascular endothelial growth factor binder combination studies

Clinical evidence teaches away from combining different types of vascular targeting agents. It has been shown that Avastin™ does not have a synergistic effect when used in combination with thalidomide, an angiogenesis inhibitor, in metastatic renal cell carcinoma (Elaraj *et al.* (2004) *J. Immunother.* 27(4) (Jul-

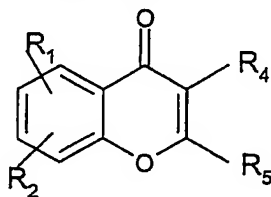
30

Aug), 259-64). Progression-free survival was the same in patients treated with Avastin™ alone or Avastin™ combined with thalidomide.

In its approved indication, colorectal cancer, Avastin™ is used in combination with 5-FU (5-fluorouracil), which does not have anti-angiogenic properties. Avastin™ has also been shown to improve median survival in breast and lung cancer patients when combined with paclitaxel. Although paclitaxel does have some anti-angiogenic properties, its primary mechanism of action in the high doses in which it is used for cancer treatment is as a cytotoxic, as described above. Therefore, this would not suggest that DMXAA would have a similar synergy with Avastin™, since DMXAA is very unlike paclitaxel in its mechanism of action and is not a cytotoxic.

#### Description of the invention

In a first aspect, the present invention provides a method for modulating neoplastic growth, which comprises administering to a mammal, including a human, in need of treatment a compound of formula (I):



Formula (I)

wherein:

- (a) R<sub>4</sub> and R<sub>5</sub> together with the carbon atoms to which they are joined, form a 6-membered aromatic ring having a substituent -R<sub>3</sub> and a radical -(B)-COOH where B is a linear or branched substituted or unsubstituted C<sub>1</sub>-C<sub>6</sub> alkylene radical, which is saturated or ethylenically unsaturated, and wherein R<sub>1</sub>, R<sub>2</sub> and R<sub>3</sub> are each independently selected from the group consisting of H, C<sub>1</sub>-C<sub>6</sub> alkyl, halogen, CF<sub>3</sub>, CN, NO<sub>2</sub>, NH<sub>2</sub>, OH, OR<sup>a</sup>, NHCOR<sup>b</sup>, NHSO<sub>2</sub>R<sup>c</sup>, SR<sup>d</sup>, SO<sub>2</sub>R<sup>e</sup> or NHR<sup>f</sup>, wherein each of R<sup>a</sup>, R<sup>b</sup>, R<sup>c</sup>, R<sup>d</sup>,

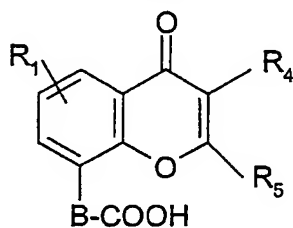
$R^e$  and  $R^f$  is independently  $C_1$ - $C_6$  alkyl optionally substituted with one or more substituents selected from hydroxy, amino and methoxy; or

- (b) one of  $R_4$  and  $R_5$  is H or a phenyl radical, and the other of  $R_4$  and  $R_5$  is H or a phenyl radical which may optionally be substituted, thienyl, furyl, naphthyl, a  $C_1$ - $C_6$  alkyl, cycloalkyl, or aralkyl radical;  $R_1$  is H or a  $C_1$ - $C_6$  alkyl or  $C_1$ - $C_6$  alkoxy radical;  $R_2$  is the radical  $-(B)-COOH$  where B is a linear or branched substituted or unsubstituted  $C_1$ - $C_6$  alkylene radical, which is saturated or ethylenically unsaturated,

or a pharmaceutically acceptable salt, ester or prodrug thereof and concomitantly or sequentially administering a vascular endothelial growth factor binder.

Where (B) in the radical  $-(B)-COOH$  is a substituted  $C_1$ - $C_6$  alkyl radical, the substituents may be alkyl, for example methyl, ethyl, propyl or isopropyl, or halide such as fluoro, chloro or bromo groups. A particularly preferred substituent is methyl.

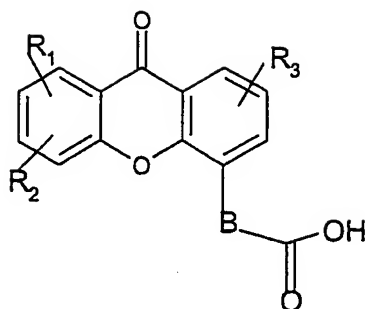
In one embodiment of the first aspect of the invention, the compound of the formula (I) as defined above is a compound of the formula (II):



Formula (II)

where  $R_1$ ,  $R_4$ ,  $R_5$  and B are as defined above for formula (I) in part (b).

In a further embodiment of the first aspect of the invention, the compound of formula (I) as defined above is a compound of the formula (III):



Formula (III)

wherein  $R_1$ ,  $R_2$  and  $R_3$  are each independently selected from the group consisting of H,  $C_1$ - $C_6$  alkyl, halogen,  $CF_3$ , CN,  $NO_2$ ,  $NH_2$ , OH,  $OR^a$ ,  $NHCOR^b$ ,  $NHSO_2R^c$ ,  $SR^d$ ,  $SO_2R^e$  or  $NHR^f$ , wherein each of  $R^a$ ,  $R^b$ ,  $R^c$ ,  $R^d$ ,  $R^e$  and  $R^f$  is independently  
 5  $C_1$ - $C_6$  alkyl optionally substituted with one or more substituents selected from hydroxy, amino and methoxy;

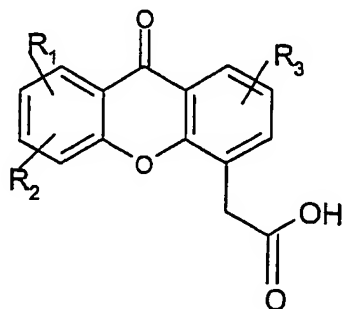
wherein B is as defined for formula (I) above;

10

and wherein in each of the carbocyclic aromatic rings in formula (I), up to two of the methine ( $-CH=$ ) groups may be replaced by an aza ( $-N=$ ) group;

and wherein any two of  $R_1$ ,  $R_2$  and  $R_3$  may additionally together represent the  
 15 group  $-CH=CH-CH=CH-$ , such that this group, together with the carbon or nitrogen atoms to which it is attached, forms a fused 6 membered aromatic ring.

For example, the compound of formula (III) may be a compound of the formula (IV):



20

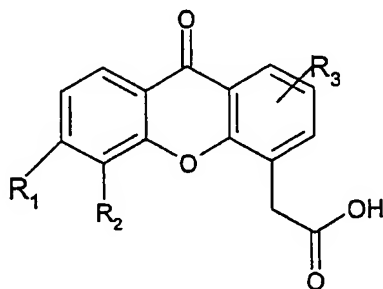
Formula (IV)

wherein  $R$ ,  $R_1$ ,  $R_2$  and  $R_3$  are as defined for formula (III).

In one embodiment of the compound of formula (IV),  $R_2$  is H, one of  $R_1$  and  $R_3$  is selected from the group consisting of  $C_1$ - $C_6$  alkyl, halogen,  $CF_3$ , CN,  $NO_2$ ,  $NH_2$ , OH,  $OR^a$ ,  $NHCOR^b$ ,  $NHSO_2R^c$ ,  $SR^d$ ,  $SO_2R^e$  or  $NHR^f$ , wherein each of  $R^a$ ,  $R^b$ ,  $R^c$ ,  $R^d$ ,  $R^e$  and  $R^f$  is independently  $C_1$ - $C_6$  alkyl optionally substituted with one or more substituents selected from hydroxy, amino and methoxy, and the other of  $R_1$  and  $R_3$  is H.

In one embodiment, in the compound of formula (I)  $R_4$  is H or a phenyl radical,  $R_5$  is H or a phenyl radical which may optionally be substituted, thienyl, furyl, naphthyl, a  $C_1$ - $C_6$  alkyl, cycloalkyl, or aralkyl radical;  $R_1$  is H or a  $C_1$ - $C_6$  alkyl or  $C_1$ - $C_6$  alkoxy radical;  $R_2$  is radical  $-(B)-COOH$  where B is a linear or branched substituted or unsubstituted  $C_1$ - $C_6$  alkylene radical, which is saturated or ethylenically unsaturated.

For example, the compound of formula (IV) may be a compound of the formula (V):



Formula (V)

wherein R,  $R_1$ ,  $R_2$  and  $R_3$  are as defined for formula (IV).

The compound of formula (V) may be, for example, 5,6-dimethylxanthenone-4-acetic acid (DMXAA).

Pharmaceutically-acceptable salts include acid addition salts and base addition salts. Such salts may be formed by conventional means, for example by reaction of a free acid or a free base form of a compound of formula (I) with one or more equivalents of an appropriate acid or base, optionally in a solvent, or in a medium in which the salt is insoluble, followed by removal of said solvent, or said

medium, using standard techniques (e.g. *in vacuo*, by freeze-drying or by filtration). Salts may also be prepared by exchanging a counter-ion of a compound of the invention in the form of a salt with another counter-ion, for example using a suitable ion exchange resin.

5

Compounds of the invention may contain double bonds and may thus exist as *E* (*entgegen*) and *Z* (*zusammen*) geometric isomers about each individual double bond. All such isomers and mixtures thereof are included within the scope of the invention.

10

Compounds of the invention may also exhibit tautomerism. All tautomeric forms and mixtures thereof are included within the scope of the invention.

Compounds of the invention may also contain one or more asymmetric carbon  
15 atoms and may therefore exhibit optical and/or diastereoisomerism. Diastereoisomers may be separated using conventional techniques, e.g. chromatography or fractional crystallisation. The various stereoisomers may be isolated by separation of a racemic or other mixture of the compounds using conventional, e.g. fractional crystallisation or HPLC, techniques. Alternatively  
20 the desired optical isomers may be made by reaction of the appropriate optically active starting materials under conditions which will not cause racemisation or epimerisation (i.e. a 'chiral pool' method), by reaction of the appropriate starting material with a 'chiral auxiliary' which can subsequently be removed at a suitable stage, by derivatisation (i.e. a resolution, including a dynamic resolution), for  
25 example with a homochiral acid followed by separation of the diastereomeric derivatives by conventional means such as chromatography, or by reaction with an appropriate chiral reagent or chiral catalyst all under conditions known to the skilled person. All stereoisomers and mixtures thereof are included within the scope of the invention.

30

In another aspect, the present invention provides the use of a vascular endothelial growth factor binder for the manufacture of a medicament (e.g. a unit dose of the medicament), for simultaneous, separate or sequential administration with a

compound of formula (I) as defined above or a pharmaceutically acceptable salt, ester or prodrug thereof (e.g. a unit dose of the compound of formula (I) as defined above or a pharmaceutically acceptable salt, ester or prodrug thereof), for the modulation of neoplastic growth.

5

In a further aspect, the invention provides the use of a compound of formula (I) as defined above or a pharmaceutically acceptable salt or ester thereof for the manufacture of a medicament (e.g. a unit dose of the medicament), for simultaneous, separate or sequential administration with a vascular endothelial growth factor binder (e.g. a unit dose of the vascular endothelial growth factor binder), for the modulation of neoplastic growth.

10

According to one aspect, the neoplastic growth is a tumour and/or a cancer.

15 In a further aspect, the cancer is one or more of ovarian, prostate, lung, colorectal, breast, pancreatic and renal cancer.

In a further aspect, there is provided a pharmaceutical formulation (e.g. in a unit dose) comprising a combination of a compound of formula (I) as defined above or a pharmaceutically acceptable salt or ester or prodrug thereof (e.g. in a unit dose) and a vascular endothelial growth factor binder (e.g. in a unit dose).

20

In one embodiment there is provided a compound according to formula (I) or a pharmaceutically acceptable salt, ester or prodrug thereof and a vascular endothelial growth factor binder for use (in combination) as a medicament for the modification of neoplastic growth.

25

Furthermore, the invention also provides a kit comprising in combination for simultaneous, separate or sequential use in modulating neoplastic growth, a compound of formula (I) as defined above or a pharmaceutically acceptable salt or ester or prodrug thereof and a vascular endothelial growth factor binder.

30

The compound of formula (I) as defined above or pharmaceutically acceptable salt or ester or prodrug thereof and the vascular endothelial growth factor binder may be administered sequentially or concomitantly. For example, the compound of formula (I) as defined above or pharmaceutically acceptable salt, ester or prodrug thereof and the vascular endothelial growth factor binder may be administered concomitantly.

In one embodiment, the pharmaceutically acceptable salt is a sodium salt.

10 The compound of formula (I) as defined above or pharmaceutically acceptable salt, ester or prodrug thereof and the vascular endothelial growth factor binder may be administered simultaneously, separately or sequentially.

In one embodiment, the vascular endothelial growth factor binder is a monoclonal antibody.

In a further embodiment, vascular endothelial growth factor binder (VEGF) is Avastin™ (bevacizumab).

20 The amount of a combination of a compound of formula (I) as defined above or pharmaceutically acceptable salt, ester or prodrug thereof and a vascular, endothelial growth factor binder required to be effective as a modulator of neoplastic growth, or a combination that further comprises a taxane, will, of course vary and is ultimately at the discretion of the medical practitioner. The factors to be considered include the route of administration and nature of the formulation, the mammal's bodyweight, age and general condition and the nature and severity of the disease to be treated.

30 A suitable effective dose of a compound of formula (I) as defined above, or a pharmaceutically acceptable salt, ester or prodrug thereof, for administration, concomitantly or sequentially, with a vascular endothelial growth factor binder, for the treatment of cancer is in the range of 600 to 4900 mg/m<sup>2</sup>. For example from 2500 to 4000 mg/m<sup>2</sup>, for example from 1200 to 3500 mg/m<sup>2</sup>, for example

from 2000 to 3000 mg/m<sup>2</sup>, for example from 1200 to 2500 mg/m<sup>2</sup>, for example from 2500 to 3500 mg/m<sup>2</sup>, for example from 2250 to 2750 mg/m<sup>2</sup>.

5 A suitable effective dose of vascular endothelial growth factor binder, for administration concomitantly or sequentially with a compound of formula (I) as defined above or pharmaceutically acceptable salt, ester or prodrug thereof for the treatment of cancer is in the range of 1-10 mg/kg, for example about 5 mg/kg.

10 In a further embodiment, a suitable effective dose of vascular endothelial growth factor binder, for administration concomitantly or sequentially with a compound of formula (I) as defined above or pharmaceutically acceptable salt, ester or prodrug thereof for the treatment of cancer is in the range from 1 to 30 mg/kg, for example from about 10 to about 20 mg/kg and more particularly about 15 mg/kg.

15 A compound of formula (I) as defined above or pharmaceutically acceptable salt, ester or prodrug thereof and the vascular endothelial growth factor binder may be administered in any suitable form, for example in the form of a pharmaceutical formulation.

20 Pharmaceutical formulations comprise the active ingredients (that is, the combination of a compound of formula (I) as defined above or pharmaceutically acceptable salt, ester or prodrug thereof and the vascular endothelial growth factor binder, for example together with one or more pharmaceutically acceptable carriers therefor and optionally other therapeutic and/or prophylactic ingredients.

25 The carrier(s) must be acceptable in the sense of being compatible with the other ingredients in the formulation and not deleterious to the recipient thereof.

Accordingly, the present invention provides a pharmaceutical formulation comprising a combination of a compound of formula (I) as defined above or  
30 pharmaceutically acceptable salt, ester or prodrug thereof (e.g. a unit dose of a compound of formula (I) as defined above or pharmaceutically acceptable salt, ester or prodrug thereof) and a vascular endothelial growth factor binder (e.g. a

unit dose of the vascular endothelial growth factor binder), for example in association with one or more pharmaceutically acceptable carriers therefor.

5 The invention further provides a process for the preparation of a pharmaceutical formulation which process comprises bringing into association a combination of a compound of formula (I) as defined above or a pharmaceutically acceptable salt, ester or prodrug thereof (e.g. a unit dose of a compound of formula (I) as defined above or pharmaceutically acceptable salt, ester or prodrug thereof) and a vascular endothelial growth factor binder (e.g. a unit dose of the vascular endothelial growth factor binder) optionally together with one or more pharmaceutically acceptable carriers therefor in. For example, the pharmaceutical formulation may be in a unit dose.

15 The pharmaceutical formulation may be delivered intravenously. The pharmaceutical formulation for intravenous administration may be used in the form of sterile aqueous solutions or in an oleaginous vehicle which may contain other substances, for example, enough salts or glucose to make the solution isotonic with blood. The aqueous solutions may be buffered (e.g. to a pH from 3 to 9), if necessary.

20 As used herein, the term "prodrug" includes entities that have certain protected group(s) and which may not possess pharmacological activity as such, but may, in certain instances, be administered (such as orally or parenterally) and thereafter metabolised in the body to form the agent which are pharmacologically active.

25 Further anti-cancer agents or therapies may be used in conjunction with the combination of a compound of formula (I) (e.g. DMXAA) and a vascular endothelial growth factor binder (e.g. bevacizumab). Particular anti-cancer agents that may be mentioned in this respect include taxanes. Thus, further embodiments of the invention include the following (in which embodiments, references to compounds of formula (I) include references to compounds of formula (II), (III), (IV) or (V)).

30

- (A) A method for modulating neoplastic growth, which method comprises administering to a mammal, including a human, in need of such treatment a compound of formula (I), as hereinbefore defined, or a pharmaceutically acceptable salt, ester or prodrug thereof and concomitantly or sequentially administering:
- 5 (i) a vascular endothelial growth factor binder; and  
(ii) a taxane.
- (B) The use of a vascular endothelial growth factor binder for the manufacture of a medicament (e.g. a unit dose of the medicament) for simultaneous, separate or sequential administration with:
- 10 (i) a compound of formula (I), as hereinbefore defined, or a pharmaceutically acceptable salt, ester or prodrug thereof (e.g. a unit dose of the compound of formula (I), as hereinbefore defined,  
15 or a pharmaceutically acceptable salt, ester or prodrug thereof); and  
(ii) a taxane (e.g. a unit dose of the taxane),  
for the modulation of neoplastic growth.
- (C) The use of a compound of formula (I), as hereinbefore defined, or a pharmaceutically acceptable salt, ester or prodrug thereof for the manufacture of a medicament (e.g. a unit dose of the medicament) for simultaneous, separate or sequential administration with:
- 20 (i) a vascular endothelial growth factor binder (e.g. a unit dose of the vascular endothelial growth factor binder); and  
25 (ii) a taxane (e.g. a unit dose of the taxane),  
for the modulation of neoplastic growth.
- (D) The use of a taxane for the manufacture of a medicament (e.g. a unit dose of the medicament) for simultaneous, separate or sequential administration with:
- 30 (i) a vascular endothelial growth factor binder (e.g. a unit dose of the vascular endothelial growth factor binder); and

- (ii) a compound of formula (I), as hereinbefore defined, or a pharmaceutically acceptable salt, ester or prodrug thereof (e.g. a unit dose of the compound of formula (I), as hereinbefore defined, or a pharmaceutically acceptable salt, ester or prodrug thereof),  
5 for the modulation of neoplastic growth.
- (E) A pharmaceutical formulation (e.g. in a unit dose) comprising a combination of a compound of formula (I), as hereinbefore defined, or a pharmaceutically acceptable salt, ester or prodrug thereof (e.g. in a unit  
10 dose), a vascular endothelial growth factor binder (e.g. in a unit dose) and a taxane (e.g. in a unit dose).
- (F) A compound of formula (I), as hereinbefore defined, or a pharmaceutically acceptable salt, ester or prodrug thereof, a vascular endothelial growth  
15 factor binder and a taxane for use (in combination) as a medicament for the modification of neoplastic growth.
- (G) A kit comprising in combination for simultaneous, separate or sequential use in modulating neoplastic growth:
- 20 (i) a compound of formula (I), as hereinbefore defined, or a pharmaceutically acceptable salt or ester or prodrug thereof;  
(ii) a vascular endothelial growth factor binder; and  
(iii) a taxane.
- 25 (H) A process for the preparation of a pharmaceutical formulation as defined at (E) above, which process comprises bringing into association a combination of a compound of formula (I), as hereinbefore defined, or a pharmaceutically acceptable salt, ester or prodrug thereof (e.g. a unit dose  
30 of a compound of formula (I) as defined above or pharmaceutically acceptable salt, ester or prodrug thereof), a vascular endothelial growth factor binder (e.g. a unit dose of the vascular endothelial growth factor binder) and a taxane (e.g. a unit dose of the taxane), optionally together with one or more pharmaceutically acceptable carriers therefor.

In the above embodiments of the invention, the taxane may, in particular, be paclitaxel or docetaxel.

In relation to the above embodiments of the invention, a suitable effective dose of taxane (e.g. paclitaxel), for administration concomitantly or sequentially with a compound of formula (I) as defined above or pharmaceutically acceptable salt, ester or prodrug thereof and a vascular endothelial growth factor binder for the treatment of cancer is in the range from 1 to 10 mg/kg, for example from about 4 to about 5 mg/kg.

Alternatively, a suitable effective dose of taxane (e.g. paclitaxel) is in the range of 100 to 250 mg/m<sup>2</sup>, such as from about 175 to about 200 mg/m<sup>2</sup>.

#### Description of the Figures

Figure 1: shows the average tumour volume (relative to the average volume on the first day of treatment) for HT29 (colorectal) xenografts observed for an untreated control group of mice and for mice given (i.e. treated with) Avastin™ (alone), DMXAA (alone), or a combination of Avastin™ and DMXAA.

Figure 2: is a representation of the same data used to generate Figure 1, but expressed in terms of the percentage of mice having tumour volume less than four times the volume measured on the first day of treatment.

Figures 3 and 4: show equivalent data to Figures 1 and 2, respectively, but for A549 (lung carcinoma) xenografts.

Figure 5: shows the average tumour volume (relative to the average volume on the first day of treatment) for A549 (lung carcinoma) xenografts observed for an untreated control group of mice and for mice given (i.e. treated with) Avastin™ (alone), DMXAA (alone), paclitaxel (alone) or a combination of Avastin™, paclitaxel and DMXAA.

Figure 6: is a representation of the same data used to generate Figure 5, but expressed in terms of the percentage of mice having tumour volume less than four times the volume measured on the first day of treatment.

## 5 Examples

### Example 1

#### *Method*

10

Xenografts for human lung and colorectal cancers are set-up in groups of nude, athymic mice. The cell lines selected are HT29 (ATCC number HTB-38), a colorectal adenocarcinoma, and A549 (ATCC number CCL-185), a lung carcinoma.

15

The A549 and HT29 cell lines are selected as DMXAA has previously been shown to be effective in these cell lines when used in combination with paclitaxel or 5-FU in xenograft studies.. In addition, Avastin™ is currently approved for treatment of colorectal cancer in combination with 5-FU and approval is being sought for use on breast and non-small cell lung carcinoma.

20

Group	Cell line	Treatment	Dose level (mg/kg)	No. of mice
1	A549	Untreated control	-	10
2	A549	DMXAA	21	10
3	A549	Avastin™	5	10
4	A549	DMXAA + Avastin™	21 & 5	10
5	HT29	Untreated control	-	10
6	HT29	DMXAA	21	10
7	HT29	Avastin™	5	10
8	HT29	DMXAA + Avastin™	21 & 5	10

DMXAA has been given previously using a day (D) 0, 4 and 8 schedule when used in combination with paclitaxel or docetaxel. For this study, DMXAA is given twice in each of Weeks 1 and 4 of the study. Avastin™ is given twice weekly for four weeks.

5

Xenografts are measured two or three times per week and their absolute volume recorded; xenograft tumour volume relative to that recorded on Day 0 ( $V_0$ ) is then calculated. The time taken to reach a relative tumour volume of  $3 \times V_0$  is used as a surrogate marker for survival.

10

### Results

Tables 1A, 1B, 2A and 2B below, as well as Figures 1 to 4 show that the combination of Avastin™ and DMXAA provides an unexpected synergistic effect in delaying tumour growth.

15

Table 1A. Results of studies with HT29 xenografts.

Group	Dose (mg/kg by injection)	Drug deaths	Median VQT (Days)	Tumour Growth Delay <sup>a1</sup> (Days)	Regression Duration <sup>b1</sup> (Days)	TTP <sup>c1</sup> (Days)
Untreated Controls	-	-	17	-	0	4
Avastin™	5	0/11	34	17	0	4
DMXAA	21	5/11	46	29	10	16
Avastin™/ DMXAA	5 + 21	4/11	57	40	10	18

<sup>a1</sup> The difference in days for treated versus control tumours to quadruple in volume (control tumours quadrupled in 17 days).

<sup>b1</sup> Tumour regression duration is the number of days that the tumour volume is less than the original treatment volume.

20

<sup>c1</sup> TTP: Median time to disease progression

**Table 1B.** Results of studies with HT29 xenografts.

Group	Dose (mg/kg by injection)	Response <sup>d1</sup>			
		PD	PR	SD	CR
Untreated Controls	-	0	0	0	0
Avastin <sup>TM</sup>	5	11	0	0	0
DMXAA	21	5	1	0	0
Avastin <sup>TM</sup> / DMXAA	5 + 21	6	1	0	0

<sup>d1</sup> PD: Progressive Disease ( $\geq 50\%$  increase in tumour size)

PR: Partial Response ( $\geq 50\%$  reduction in tumour size sustained over two weeks)

SD: Stable Disease (does not satisfy criteria for PR or PD)

5 CR: Complete Response (cure; undetectable tumour over two weeks)

**Table 2A.** Results of studies with A549 xenografts.

Group	Dose (mg/kg by injection)	Drug deaths	Median VQT (Days)	Tumour Growth Delay <sup>a2</sup> (Days)	Regression Duration <sup>b2</sup> (Days)	TTP <sup>c2</sup> (Days)
Untreated Controls	-	-	25	-	0	5
Avastin <sup>TM</sup>	5	0/12	67	42	0	8
DMXAA	21	1/12	57	32	0	14
Avastin <sup>TM</sup> / DMXAA	5 + 21	2/12	104	79	52	68

<sup>a2</sup> The difference in days for treated versus control tumours to quadruple in volume (control tumours quadrupled in 25 days).

10 <sup>b2</sup> Tumour regression duration is the number of days that the tumour volume is less than the original treatment volume.

<sup>c2</sup> TTP: Median time to disease progression

Table 2B. Results of studies with A459 xenografts.

Group	Dose (mg/kg by injection)	Response <sup>d2</sup>			
		PD	PR	SD	CR
Untreated Controls	-	0	0	0	0
Avastin <sup>TM</sup>	5	11	1	0	0
DMXAA	21	11	0	0	0
Avastin <sup>TM</sup> / DMXAA	5 + 21	2	7	1	0

<sup>d2</sup> PD: Progressive Disease ( $\geq 50\%$  increase in tumour size)

PR: Partial Response ( $\geq 50\%$  reduction in tumour size sustained over two weeks)

SD: Stable Disease (does not satisfy criteria for PR or PD)

5 CR: Complete Response (cure; undetectable tumour over two weeks)

## Example 2

### Method

10

The experimental set-up of this example with respect to the xenografts, mice and cell line is as described in Example 1 above.

Group	Cell line	Treatment	Dose level (mg/kg)	No. of mice
1	A549	Untreated control	-	11
2	A549	DMXAA	21	11
3	A549	Avastin <sup>TM</sup>	5	11
4	A549	Paclitaxel	5	11
5	A549	DMXAA + Paclitaxel + Avastin <sup>TM</sup>	21, 5 & 5	11

15 DMXAA has been given previously using a day (D) 0, 4 and 8 schedule when used in combination with paclitaxel or docetaxel. For this study, DMXAA is given twice in each of Weeks 1 and 4 of the study. Avastin<sup>TM</sup> is given twice weekly for four weeks. For this study, Paclitaxel is given twice in each of Weeks 1 and 4 of the study.

Xenografts are measured two or three times per week and their absolute volume recorded; xenograft tumour volume relative to that recorded on Day 0 ( $V_0$ ) is then calculated. The time taken to reach a relative tumour volume of  $3 \times V_0$  is used as a surrogate marker for survival.

5

### Results

Tables 3A and 3B below, as well as Figures 5 and 6 show that the combination of Avastin™, Paclitaxel and DMXAA provides an unexpected synergistic effect in  
10 delaying tumour growth.

**Table 3A.** Results of studies with A549 xenografts.

Group	Dose (mg/kg by injection)	Drug deaths	Median VQT (Days)	Tumour Growth Delay <sup>a3</sup> (Days)	Regression Duration <sup>b3</sup> (Days)	TTP <sup>c3</sup> (Days)
Untreated Controls	-	-	25	-	0	7
Paclitaxel	5	0/11	28	3	0	7
Avastin™	5	0/11	> 42	> 17	0	7
DMXAA	21	4/11	> 46	> 21	0	7
Paclitaxel/ Avastin™/ DMXAA	5 + 5 + 21	1/11	> 46	> 46	> 46	42

<sup>a3</sup> The difference in days for treated versus control tumours to quadruple in volume (control tumours quadrupled in 25 days).

15 <sup>b3</sup> Tumour regression duration is the number of days that the tumour volume is less than the original treatment volume.

<sup>c3</sup> TTP: Median time to disease progression.

Table 3B. Results of studies with A549 xenografts.

Group	Dose (mg/kg by injection)	Response <sup>d3</sup>			
		PD	PR	SD	CR
Untreated Controls	-	11	0	0	0
Paclitaxel	5	11	0	0	0
Avastin <sup>TM</sup>	5	11	0	0	0
DMXAA	21	7	0	0	0
Paclitaxel/ Avastin <sup>TM</sup> / DMXAA	5 + 5 + 21	0	4	4	2

<sup>d3</sup> PD: Progressive Disease ( $\geq 50\%$  increase in tumour size)

PR: Partial Response ( $\geq 50\%$  reduction in tumour size sustained over two weeks)

SD: Stable Disease (does not satisfy criteria for PR or PD)

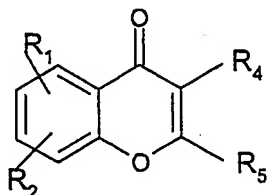
5 CR: Complete Response (cure; undetectable tumour over two weeks)

### Abbreviations

	AUC	=	area under plasma concentration curve
	CR	=	Complete Response
10	DMXAA	=	5,6-dimethylxanthenone-4-acetic acid
	ENL	=	erythema nodosum leprosum
	5-FU	=	5-fluorouracil
	ICAM	=	intracellular adhesion molecule
	i.p.	=	intraperitoneal
15	MRI	=	magnetic resonance imaging
	NSAID	=	non-steroidal anti-inflammatory drug
	PD	=	Progressive Disease
	PK	=	pharmacokinetics
	PR	=	Partial Response
20	SD	=	Stable Disease
	VEGF	=	vascular endothelial growth factor
	VDA	=	vascular disrupting agent
	VQT	=	(tumour) volume quadrupling time

## CLAIMS

1. A method for modulating neoplastic growth, which comprises administering to a mammal, including a human, in need of treatment a compound of Formula (I):



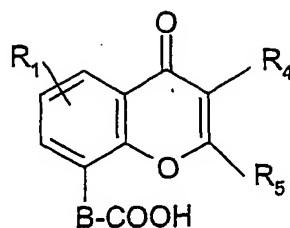
Formula (I)

wherein:

- (a)  $R_4$  and  $R_5$  together with the carbon atoms to which they are joined, form a 6-membered aromatic ring having a substituent  $-R_3$  and a radical  $-(B)-COOH$  where B is a linear or branched substituted or unsubstituted  $C_1-C_6$  alkylene radical, which is saturated or ethylenically unsaturated, and wherein  $R_1$ ,  $R_2$  and  $R_3$  are each independently selected from the group consisting of H,  $C_1-C_6$  alkyl, halogen,  $CF_3$ , CN,  $NO_2$ ,  $NH_2$ , OH,  $OR^a$ ,  $NHCOR^b$ ,  $NHSO_2R^c$ ,  $SR^d$ ,  $SO_2R^e$  or  $NHR^f$ , wherein each of  $R^a$ ,  $R^b$ ,  $R^c$ ,  $R^d$ ,  $R^e$  and  $R^f$  is independently  $C_1-C_6$  alkyl optionally substituted with one or more substituents selected from hydroxy, amino and methoxy; or
- (b) one of  $R_4$  and  $R_5$  is H or a phenyl radical, and the other of  $R_4$  and  $R_5$  is H or a phenyl radical which may optionally be substituted, thienyl, furyl, naphthyl, a  $C_1-C_6$  alkyl, cycloalkyl, or aralkyl radical;  $R_1$  is H or a  $C_1-C_6$  alkyl or  $C_1-C_6$  alkoxy radical;  $R_2$  is the radical  $-(B)-COOH$  where B is a linear or branched substituted or unsubstituted  $C_1-C_6$  alkylene radical, which is saturated or ethylenically unsaturated,

or a pharmaceutically acceptable salt, ester or prodrug thereof and concomitantly or sequentially administering a vascular endothelial growth factor binder.

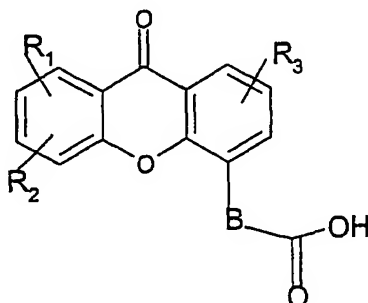
2. The method according to Claim 1 wherein the compound of Formula (I) is a compound of Formula (II):



Formula (II)

5 wherein R<sub>1</sub>, R<sub>4</sub>, R<sub>5</sub> and B are as defined for formula (I) in Claim 1 part (b).

3. The method according to Claim 1 wherein the compound of Formula (I) is a compound of Formula (III):



Formula (III)

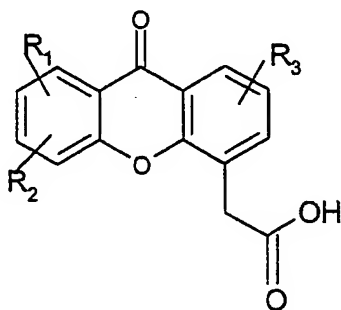
10 wherein R<sub>1</sub>, R<sub>2</sub> and R<sub>3</sub> are each independently selected from the group consisting of H, C<sub>1</sub>-C<sub>6</sub> alkyl, halogen, CF<sub>3</sub>, CN, NO<sub>2</sub>, NH<sub>2</sub>, OH, OR<sup>a</sup>, NHCOR<sup>b</sup>, NHSO<sub>2</sub>R<sup>c</sup>, SR<sup>d</sup>, SO<sub>2</sub>R<sup>e</sup> or NHR<sup>f</sup>, wherein each of R<sup>a</sup>, R<sup>b</sup>, R<sup>c</sup>, R<sup>d</sup>, R<sup>e</sup> and R<sup>f</sup> is independently C<sub>1</sub>-C<sub>6</sub> alkyl optionally substituted with one or more substituents selected from  
15 hydroxy, amino and methoxy;

wherein B is as defined for formula (I) in Claim 1;

and wherein in each of the carbocyclic aromatic rings in formula (I), up to two of  
20 the methine (-CH=) groups may be replaced by an aza (-N=) group;

and wherein any two of  $R_1$ ,  $R_2$  and  $R_3$  may additionally together represent the group  $-\text{CH}=\text{CH}-\text{CH}=\text{CH}-$ , such that this group, together with the carbon or nitrogen atoms to which it is attached, forms a fused 6 membered aromatic ring.

- 5 4. The method according to Claim 3, wherein the compound of Formula (III) is a compound of Formula (IV):

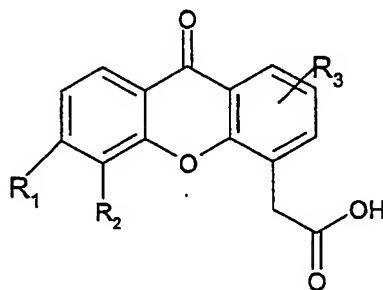


Formula (IV)

wherein  $R$ ,  $R_1$ ,  $R_2$  and  $R_3$  are as defined for formula (III) in Claim 3.

10

5. The method according to Claim 4 wherein the compound of Formula (IV) is a compound of Formula (V):



Formula (V)

- 15 wherein  $R$ ,  $R_1$ ,  $R_2$  and  $R_3$  are as defined for formula (IV) in Claim 4.

6. The method according to Claim 1, wherein the compound of Formula (I) is DMXAA or a pharmaceutically acceptable salt, ester or prodrug thereof.

- 20 7. The method according to any one of the preceding claims, which method further comprises administering to a mammal, including a human, in need of treatment a taxane.

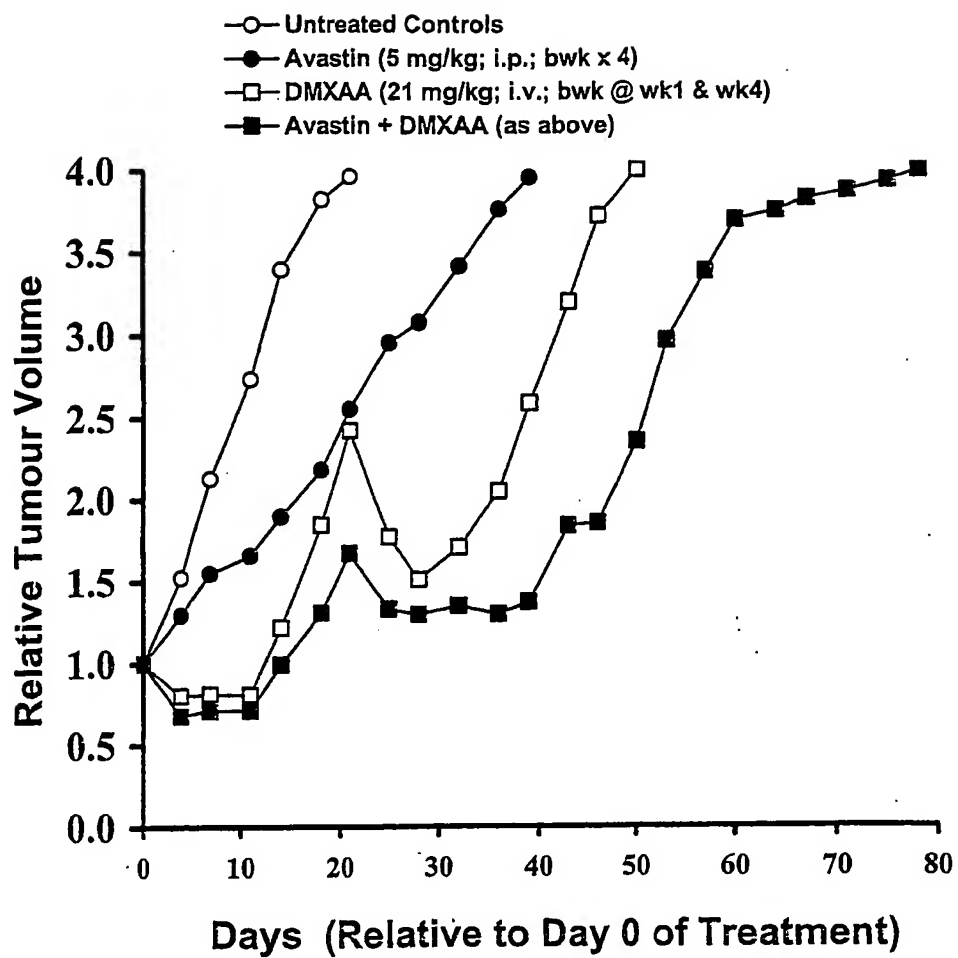
8. A method according to any of Claims 1 to 6 wherein the compound of formula (I) or a pharmaceutically acceptable salt, ester or prodrug thereof and the vascular endothelial growth factor binder are administered concomitantly.
- 5 9. A method according to any one of the Claims 1 to 6 wherein the compound of formula (I) or pharmaceutically acceptable salt, ester or prodrug thereof and the vascular endothelial growth factor binder are administered sequentially.
- 10 10. The method according to any one of the preceding claims wherein the vascular endothelial growth factor binder is a monoclonal antibody.
11. The method according to Claim 10 wherein the vascular endothelial growth factor binder is Avastin™ (bevacizumab).
- 15 12. The method according to any one of Claims 7, 10 and 13 wherein the taxane is paclitaxel or docetaxel.
13. The method according to any one of the preceding claims wherein the method further comprises modulation of neoplastic growth in one of more of  
20 ovarian, prostate, lung, colorectal, pancreatic, breast and renal cancer.
14. Use of a compound of formula (I), (II), (III), (IV) or (V), as defined in any one of Claims 1 to 6, or a pharmaceutically acceptable salt, ester or prodrug thereof, for simultaneous, separate or sequential administration with a vascular  
25 endothelial growth factor binder, for the modulation of neoplastic growth.
15. Use of a vascular endothelial growth factor binder for the manufacture of a medicament for simultaneous, separate or sequential administration with a compound of formula (I), (II), (III), (IV) or (V), as defined in any one of Claims 1  
30 to 6, or a pharmaceutically acceptable salt, ester or prodrug thereof, for the modulation of neoplastic growth.

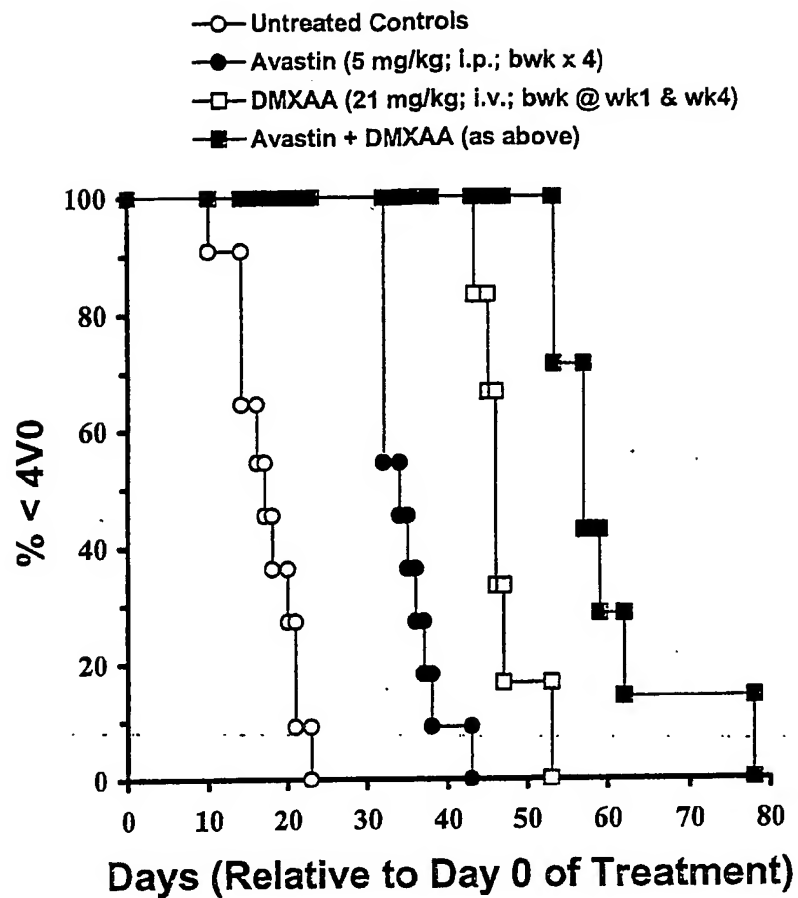
16. Use of a compound of formula (I), (II), (III), (IV) or (V), as defined in any one of Claims 1 to 6, or a pharmaceutically acceptable salt, ester or prodrug thereof for the manufacture of a medicament for simultaneous, separate or sequential administration with a vascular endothelial growth factor binder, for the modulation of neoplastic growth.
17. The use of a vascular endothelial growth factor binder for the manufacture of a medicament for simultaneous, separate or sequential administration with:
- (i) a compound of formula (I), (II), (III), (IV) or (V), as defined in any one of Claims 1 to 6, or a pharmaceutically acceptable salt, ester or prodrug thereof; and
- (ii) a taxane,
- for the modulation of neoplastic growth.
18. The use of a compound of formula (I), (II), (III), (IV) or (V), as defined in any one of Claims 1 to 6, or a pharmaceutically acceptable salt, ester or prodrug thereof for the manufacture of a medicament for simultaneous, separate or sequential administration with:
- (i) a vascular endothelial growth factor binder; and
- (ii) a taxane,
- for the modulation of neoplastic growth.
19. The use of a taxane for the manufacture of a medicament for simultaneous, separate or sequential administration with:
- (i) a vascular endothelial growth factor binder; and
- (ii) a compound of formula (I), (II), (III), (IV) or (V), as defined in any one of Claims 1 to 6, or a pharmaceutically acceptable salt, ester or prodrug thereof,
- for the modulation of neoplastic growth.
20. Use according to any one of Claims 14 to 19 wherein the vascular endothelial growth factor binder is a monoclonal antibody.

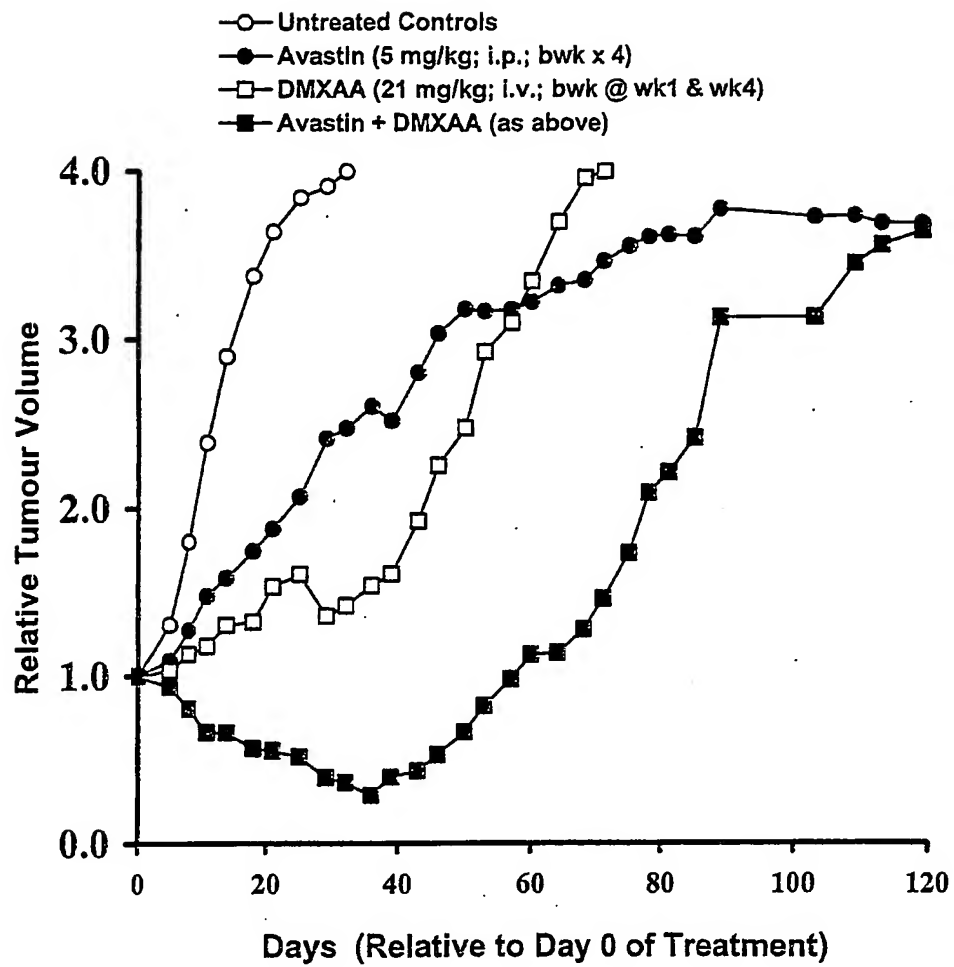
21. Use according to Claim 20 wherein the vascular endothelial growth factor is Avastin™ (bevacizumab).
- 5 22. Use according to any one of Claims 14 to 21 wherein the compound of formula (I), (II), (III), (IV) or (V) is DMXAA or a pharmaceutically acceptable salt, ester or prodrug thereof.
23. Use according to any one of Claims 14 to 22 wherein the modulation of  
10 neoplastic growth is in one of more of ovarian, prostate, lung, colorectal, pancreatic, breast and renal cancer.
24. Use according to any one of Claims 17 to 23 wherein the taxane is paclitaxel or docetaxel.
- 15 25. A pharmaceutical formulation comprising a combination of a compound of formula (I), (II), (III), (IV) or (V), as defined in any one of Claims 1 to 6, or a pharmaceutically acceptable salt, ester or prodrug thereof, and a vascular endothelial growth factor binder.
- 20 26. The pharmaceutical formulation of Claim 25 wherein the pharmaceutical formulation further comprises a pharmaceutically acceptable carrier.
27. A pharmaceutical formulation according to Claim 25 or Claim 26 wherein  
25 the formulation is adapted for intravenous administration.
28. A pharmaceutical formulation according to any one of Claims 25 to 27 wherein the vascular endothelial growth factor binder is bevacizumab.
- 30 29. A pharmaceutical formulation according to any one of Claims 25 to 28 wherein the compound of formula (I), (II), (III), (IV) or (V) is DMXAA or a pharmaceutically acceptable salt, ester or prodrug thereof.

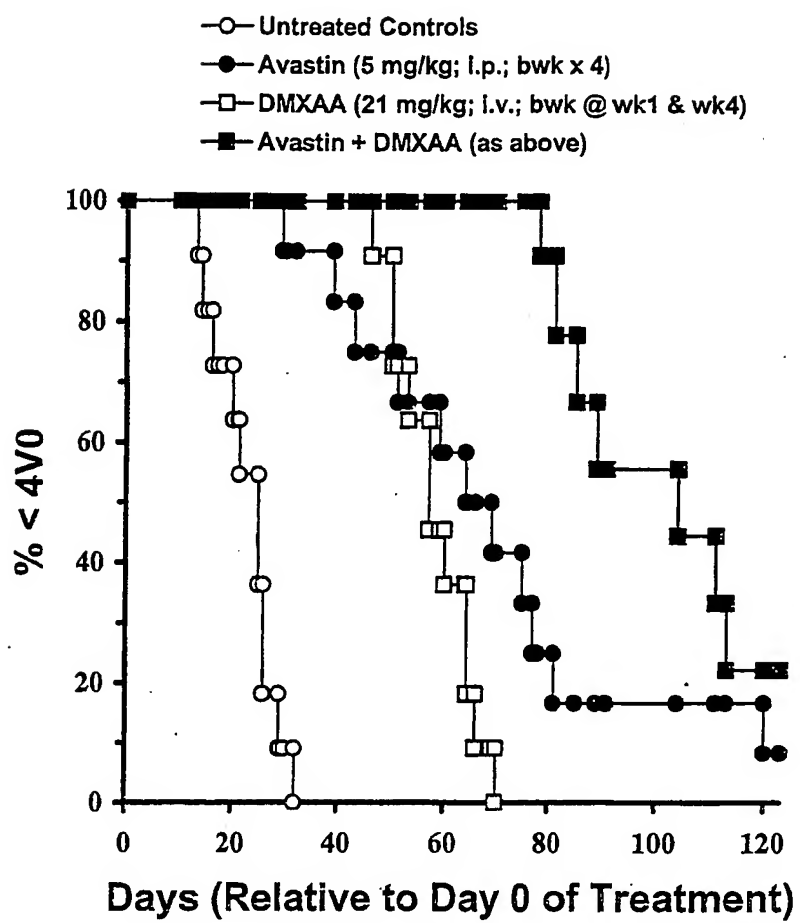
30. A pharmaceutical formulation according to any one of Claims 25 to 29 further comprising a taxane.
31. A pharmaceutical formulation according to Claim 30 wherein the taxane is  
5 paclitaxel or docetaxel.
32. A kit comprising, in combination for simultaneous, separate or sequential use in modulating neoplastic growth, a compound of formula (I), (II), (III), (IV) or (V), as defined in any one of Claims 1 to 6, or a pharmaceutically acceptable salt,  
10 ester or prodrug thereof and a vascular endothelial growth factor binder.
33. The kit according to Claim 32 wherein the growth factor inhibitor is bevacizumab.
- 15 34. The kit according to Claim 32 or Claim 33 wherein the compound of formula (I) is DMXAA or a pharmaceutically acceptable salt, ester or prodrug thereof.
35. The kit according to any one of Claims 32 to 34 further comprising, in  
20 combination for simultaneous, separate or sequential use in modulating neoplastic growth, a taxane.
36. The kit according to Claim 35 wherein the taxane is paclitaxel or docetaxel.

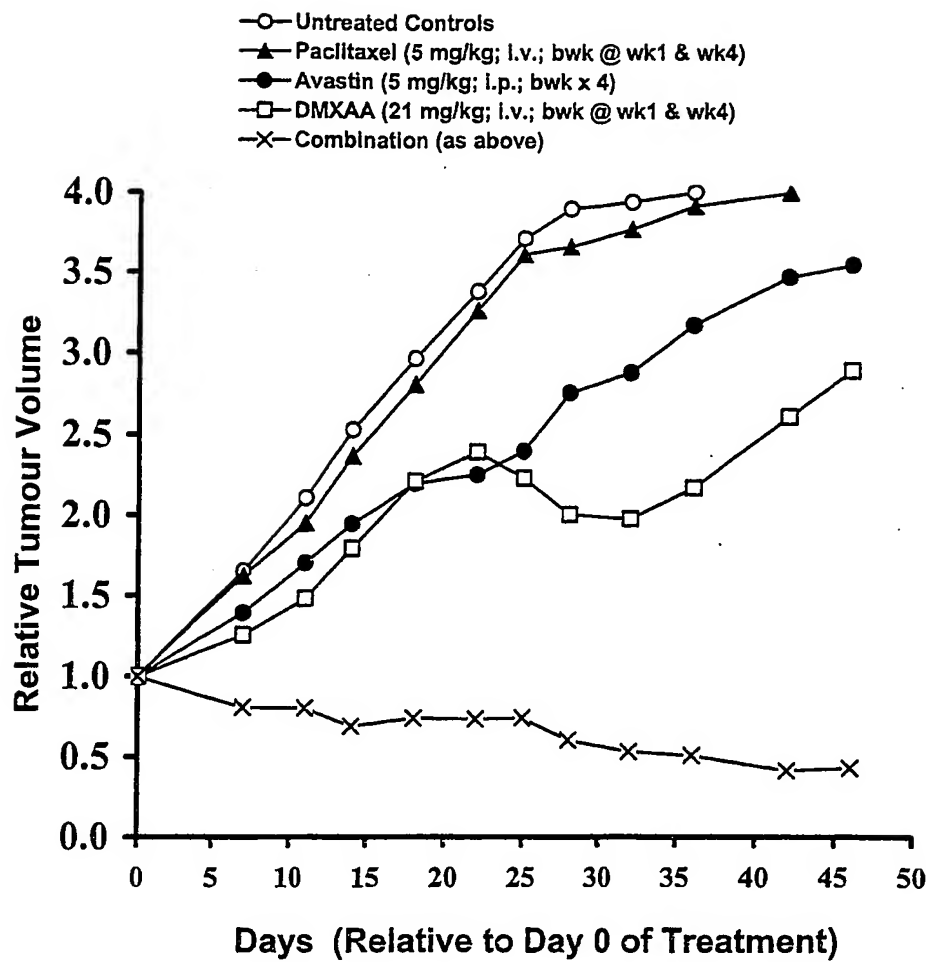
25

**Fig. 1.**

**Fig. 2.**

**Fig. 3.**

**Fig. 4.**

**Fig. 5.**

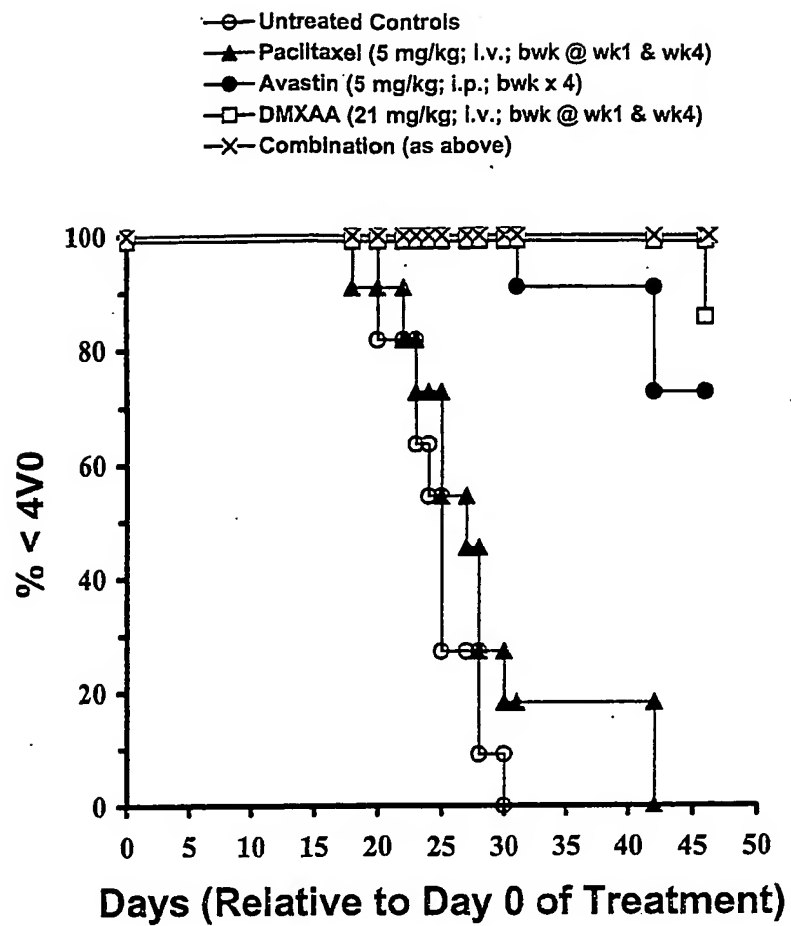


Fig. 6.

## INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2006/003196

## A. CLASSIFICATION OF SUBJECT MATTER

INV. A61K31/352 A61K39/395 A61K31/337 A61P35/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61K A61P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, BIOSIS, EMBASE, WPI Data, CHEM ABS Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	DJEHA H ET AL.: "Synergistic in vivo antitumor activity in lung and colon cancer xenografts with the vascular disrupting agent DMXAA combined with bevacizumab" PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR CANCER RESEARCH ANNUAL MEETING; 97TH ANNUAL MEETING OF THE AMERICAN ASSOCIATION-FOR-CANCER-RESEARCH (AACR), vol. 47, April 2006 (2006-04), page 55, XP001248753 Washington, DC, USA ISSN: 0197-016X abstract  ----- -/--	1-36



Further documents are listed in the continuation of Box C.



See patent family annex.

## \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*8\* document member of the same patent family

Date of the actual completion of the international search

13 December 2006

Date of mailing of the international search report

29/12/2006

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
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## INTERNATIONAL SEARCH REPORT

International application No  
PCT/GB2006/003196

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 03/020259 A2 (CANCER REC TECH LTD [GB]; WILSON WILLIAM ROBERT [NZ]; SIIM BRONWYN GAE) 13 March 2003 (2003-03-13) page 18, line 29 - page 19, line 30 table 1 page 22, paragraph 2 - page 23 -----	1-36
A	SIIM BRONWYN G ET AL: "Marked potentiation of the antitumour activity of chemotherapeutic drugs by the antivascular agent 5,6-dimethylxanthenone-4-acetic acid (DMXAA)." CANCER CHEMOTHERAPY AND PHARMACOLOGY. JAN 2003, vol. 51, no. 1, January 2003 (2003-01), pages 43-52, XP002411268 ISSN: 0344-5704 abstract -----	1-36
A	BAGULEY BRUCE C ET AL: "Potential of DMXAA combination therapy for solid tumors." EXPERT REVIEW OF ANTICANCER THERAPY. OCT 2002, vol. 2, no. 5, October 2002 (2002-10), pages 593-603, XP009076041 ISSN: 1473-7140 the whole document -----	1-36
A	KELLAND LR: "Targeting Established Tumor Vasculature: A Novel Approach to Cancer Treatment" CURR. CANCER THER. REV., vol. 1, no. 1, January 2005 (2005-01), pages 1-9, XP002411269 ISSN: 1573-3947 page 5, column 1, paragraph 3 - page 6, column 2, paragraph 3 -----	1-36

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB2006/003196

## Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:  
  
Although claims 1-14, 20-24 are directed to a method of treatment of the human/animal body, the search has been carried out and based on the alleged effects of the compound/composition.
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2006/003196

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 03020259	A2	13-03-2003	BR 0212258 A 19-10-2004
			CA 2458459 A1 13-03-2003
			CN 1708296 A 14-12-2005
			EP 1423105 A2 02-06-2004
			IS 7144 A 06-02-2004
			JP 2005509599 T 14-04-2005
			MX PA04002004 A 17-02-2005
			NO 20040591 A 30-04-2004
			NZ 531045 A 31-08-2006
			US 2004204480 A1 14-10-2004
			ZA 200401078 A 15-04-2005
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